Natural Resources Defense Council
The Bay Institute
Defenders of Wildlife

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Sent via email to: dalehf@water.ca.gov and fbarajas@mp.usbr.gov

RE: Initial Review of the BDCP Conceptual Foundation and Analytical Framework (Appendix A) and Entrainment Appendix (Appendix B)

Dear Ms. Hoffman-Floerke and Mr. Barajas,

On behalf of the Natural Resources Defense Council, the Bay Institute, and Defenders of Wildlife, we are writing to provide initial comments on the Bay Delta Conservation Plan (BDCP) Conceptual Foundation and Analytical Framework (Appendix A) and Entrainment Appendix (Appendix B). These documents are intended to describe the plan for the BDCP Effects Analysis (EA) and the first example results from that exercise. We appreciate that they have been made public and that you have sought independent scientific review from the Delta Stewardship Council. Our initial review finds that the documents:

- Lack necessary focus, clarity and structure in either the conceptual foundation or analytical framework to provide needed answers to BDCP decision-makers and the general public;
- Fail to analyze effects against a set of science-based goals and objectives that define the BDCP's legal requirement to contribute to the recovery of covered species and the conservation of natural communities;
- Ignore much of the existing scientific literature, including well-documented information on key stressors on the Bay-Delta ecosystem and covered species, make scientifically unjustified assumptions that lack citation, and instead rely on a biased subset of hypotheses and models that are not consistent with the best available scientific understanding of the system;
- Utilize an improper baseline for comparing future conditions under BDCP;
- Fail to analyze a full range of BDCP alternatives, including canal sizes and conveyance alternatives (dual vs isolated vs existing conveyance), flows, and export levels;
- Fail to adequately explain how effects, including indirect effects, will be synthesized and integrated, what standard will be used to evaluate them (as noted in our second bullet above), and whether and how the proposed project will be modified to account for what is learned from the Effects Analysis;
- Presents premature and questionable conclusions regarding the effects of BDCP and the ability to increase exports as part of its conservation strategy.

On the pages that follow, we provide more detailed comments. In general, we believe that without a fundamental refocusing of this effects analysis effort on its critical purpose—assessing each alternative's likelihood of achieving desired biological goals and objectives that define BDCP's "contribution to recovery" of the ecosystem and its covered species—this process will fail to provide necessary information to BDCP decision-makers and the general public.

Finally, we are disappointed that the detailed comments and reviews of the two documents by the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and California Department of Fish and Game were not initially provided to the independent peer review panel. We understand that the comments have since been given to the panel and publicly released, but failure of BDCP's consultants to incorporate them into their presentation to the panel led to an incomplete and biased public discussion last month. The agencies' serious concerns and criticisms with the EA documents echo many of those we describe in this letter and, thus, we look forward to working with the agencies to ensure that the EA process and its supporting documents are substantially revised.

Thank you for consideration of our views.

Sincerely,

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The Bay Institute

Christina Swanson, Ph.D.
Natural Resources Defense Council

Kim Delfino
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Comments on the BDCP Conceptual Foundation and Analytical Framework

The BDCP Conceptual Foundation and Analytical Framework (Appendix A) is supposed to provide an overview and guide to the Effects Analysis (EA) methodology. This document should include a description of the ecosystem's condition, function and key stressors affecting it (i.e., the "conceptual foundation"). The document should also include a description of what qualitative and quantitative analyses of the effects of proposed changes in the system (i.e., the "conservation measures" in the alternative being analyzed) will be conducted and how they will be evaluated (i.e., the "analytical framework"). Based on our review, the document fails to meet these basic requirements in several fundamental ways, including:

- Failure to identify either qualitative or quantitative goals and objectives, which provides little basis for evaluating EA results;
- Incomplete and biased scientific understanding of the condition, function and stressors affecting the ecosystem, exemplified by the exclusion of discussion of the role of freshwater flow as an ecological driver, of flow alterations and invasive species as stressors in the system, and reliance on a biased subset of analytical tools and models;
- Use of an improper baseline, which biases evaluation of EA results; and
- Failure to analyze a range of alternatives, which results in no meaningful comparison among alternative conservation measures and thus no basis to identify or select the project that optimally meets BDCP goals.

In order to be useful and effective as a decision and planning tool, the EA must be well integrated with the BDCP Conservation Strategy. The Conservation Strategy must, in turn, articulate BDCP's goals and objectives and specific conservation measures that, based on the best available scientific understanding of the system, will contribute to meeting those goals and objectives. Thus, in addition to analyzing specific system responses to specific management or restoration actions, the EA must also analyze the explicit and implicit assumptions made by the Conservation Strategy regarding key stressors and limiting factors in the ecosystem and whether proposed conservation measures are enough to achieve BDCP's goals. Since the EA fails to define BDCP's "*contribution to ecosystem conservation and recovery of covered species*", and does not incorporate specific descriptions of what attainment of this goal would look like (i.e., in the form of objectives that are specific, measureable, achievable, relevant, and time-bound ("SMART objectives"), the EA will be incapable of determining the likelihood that the BDCP will achieve its legal obligations through specified biological outcomes.

In addition, there is no indication from the documents that the results of this EA will be used to modify the Conservation Strategy (or the single alternative that is analyzed in the EA), despite numerous promises throughout the process that the Conservation Strategy would be revised through an iterative process based on the EA, most recently in the description of 'Scenario 6' operations.

The EA is also intended to serve as a model for evaluating BDCP's progress towards the Plan's goals and objectives following implementation (i.e. the analytical component of adaptive management). Without a clear description of how conservation measures are expected to alleviate important stressors to an extent that allows attainment of SMART objectives, there can be no effective adaptive management. Therefore, the EA will not function as a model for future BDCP adaptive management. Instead, if the approach is not significantly altered, the BDCP EA will demonstrate a muddled, ineffectual future management regime that only checks off actions that have been taken rather than assessing whether they worked as intended *and* whether they contributed towards measurably improved conservation status for the species and ecosystem characteristics of interest.

In the following sections we provide more detail and identify additional serious deficiencies in the document.

1. Neither the Conceptual Foundation nor Analytical Framework articulate or focus on the fundamental questions that should be addressed by the effects analysis.

A methodological overview of this type must provide a definitive description of the questions that the analysis will seek to answer—these overarching questions drive the analysis. Some of the fundamental questions that should drive BDCP's EA include:

- What are the magnitude and likelihood of positive impacts that the analyzed alternative will make towards ecosystem conservation/recovery of covered species and reliability of water supply?
- When will these contributions materialize and how certain are we that the projected benefits will be realized in the predicted time frame?
- What are the magnitudes and likelihoods of potential negative impacts that may arise from measures in the analyzed alternative? What are the potential outcomes (risks) if the negative impacts arise?
- What are the key uncertainties and assumptions that must be monitored/tested in ongoing study and monitoring of the impacts of project implementation?

Rather than describing how the EA will answer these and other questions relevant to decision-makers and the general public, the document instead provides a very narrow view of the potential problems that may be limiting ecosystem conservation and species recovery (stressors) as well as a long list of what appear to be pre-emptive excuses for why the BDCP may be unable to produce substantial conservation benefits.

2. The Conceptual Foundation and Analytical Framework fails to identify biological goals and objectives for covered species or the ecosystem against which projected outcomes of analyzed Conservation Strategy actions can be measured; therefore, the EA cannot determine whether the analyzed alternative is likely to accomplish BDCP's conservation and recovery obligations.

The BDCP is responsible for contributing to the conservation of natural communities and the recovery of "covered species" in the Delta, including: three populations of Chinook salmon, Central Valley steelhead, Sacramento splittail, delta smelt, longfin smelt, green sturgeon, white sturgeon, and two species of lamprey. Each of the covered species has experienced substantial declines in abundance, spatial distribution, and/or life history diversity that need to be addressed

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before it can be considered "recovered." Similarly, the natural communities of the Delta ecosystem suffer from reduction in the availability and expanse of natural habitats, disconnection of those habitats, reduced food availability at lower trophic levels, high prevalence of non-native species and, importantly, large-scale alterations in the amounts, timing and seasonal and inter-annual variability of freshwater flows that drive many natural ecosystem processes. Protection and contribution to recovery of these vital attributes must be specified as goals of the BDCP. Without clear, measureable, time-bound articulations of these goals, there is little basis for answering the questions identified above or for determining whether the BDCP represents a viable Habitat Conservation Plan (HCP)/Natural Community Conservation Plan (NCCP) or component of a Delta Plan, which are of critical importance to the public and decision-makers.

In order to demonstrate that the overarching aims (and legal requirements) of contribution towards species recovery and community conservation can be achieved, as well as how BDCP can be implemented in an adaptive management framework, BDCP *needs to* define its contribution to those outcomes in the form of both broad goals and SMART objectives. Without such targets, it will be virtually impossible to:

- gauge the potential efficacy of the BDCP prior to issuance of a 50-year take permit for endangered species,
- evaluate the BDCP's actual success or failure in delivering its anticipated benefits, and
- implement adaptive management to adjust BDCP's Conservation Strategy and/or specific conservation measures to better attain the goals and objectives.

3. <u>The Conceptual Foundation and Analytical Framework focus on an extremely narrow set of potential stressors on the ecosystem and species, exclude many other relevant and important stressors from consideration, and ignore the potential for unintended negative impacts of proposed BDCP conservation measures</u>

The forces driving recent Bay-Delta ecosystem and species declines range from the relatively well established (i.e. alteration in the timing and magnitude of freshwater flows) to the less well understood (e.g. the role of nutrient concentrations in trophic web dynamics). The document states correctly that, "*The reasons for [the pelagic organism decline] are complex and not completely understood*" [p. A-15]. We also understand that the BDCP Conservation Strategy will address some stressors more than others, in part because of the limited ability of the state and federal water projects to directly affect them. However, we find it inexplicable and a serious mischaracterization of our scientific understanding of the Bay-Delta ecosystem that the BDCP's Conceptual Foundation excludes meaningful discussion or consideration of the alteration of freshwater flows as either a stressor or an issue to be addressed by the BDCP. Alteration of freshwater flows has been identified by the State Water Resources Control Board (SWRCB) as a key physical and ecological driver in the system, and it is one that is directly related to the federal and state water project operations at the heart of the BDCP.

Instead, as described in the document, the BDCP Conservation Strategy proposes to attain (unspecified) biological outcomes by focusing on a limited set of stressors *hypothesized by some* to impair ecosystem function or species recovery while simultaneously ignoring the existence of

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other equally well (or better) documented ecosystem stressors. For example, in the section titled "Ecological Background", the document lists the four categories of stressors hypothesized to underlie the Pelagic Organism Decline: top-down drivers, bottom up drivers, prior abundance, and physical-chemical habitat conditions (Baxter et al 2010; see Figure A-4). However, in the pages that follow, the document focuses exclusively on the bottom-up (food web drivers), and the other three drivers are completely ignored.

From its limited discussion of potential drivers of bottom up effects, the document concludes:

> *[Ammonium and introduced clams] have been linked to changes in zooplankton communities and overall declines in food availability for pelagic fishes. Thus, bottom-up food limitation is likely an important driver influencing long-term fish trends in the upper estuary and has been identified as a potentially significant factor in the recent POD.* [p. A-16]

This conclusion and the discussion that precedes it completely ignore studies specific to this ecosystem and more generally which indicate that impacts to lower trophic levels (e.g. phytoplankton) rarely produce significant and concomitant responses more than one trophic level up the food web (e.g. in this case, the fish species of interest). For example, Kimmerer (2002) investigated the posited impact of introduced clams on pelagic fish populations in the Bay-Delta and found:

> *the food web appears strongly coupled between benthos [clams] and plankton, and weakly coupled between zooplankton and fish, as has been found in other systems. More importantly, the variation with freshwater flow of abundance or survival of organisms in higher trophic levels apparently did not occur through upward trophic transfer, since a similar relationship was lacking in most of the data on lower trophic levels* [p.39].

In describing the bottom-up stressors, the document only describes the putative effect of ammonium pollution and (barely) the potential effect of the introduced clam species, *Corbula amurensis*. The potential effects of BDCP on primary productivity and food supply for pelagic fish species is not described at all. Previously published research has found significant export of phytoplankton from the federal and state Delta export facilities and that in-Delta barriers, river inflows, and other water project operations can affect residence time, phytoplankton and food supply (*see, e.g.,* Brown 2003, Jassby & Cloern 2000). Given the BDCP's focus on supplementing the aquatic food web through shallow water habitat restoration projects, the EA must account for the potential loss of this productivity at critical times of year as a result of export activities, as well as the potential for any additional primary production that may be created by BDCP conservation measures to be diverted from the trophic pathways that lead to the covered fish species (e.g. by benthic grazers). The current format appears to omit key elements of this analysis.

Furthermore, there is no mention in the EA's description of bottom-up food impacts of the well-known and documented effect of freshwater flow on food web-productivity in this ecosystem. (e.g. Jassby et al. 1995; Kimmerer 2002(a, b); Rosenfield and Baxter 2007; Sommer et al 2007;

Mac Nally et al. 2010). The document fails to describe the primacy of flow variables in the section titled "Ecological Drivers" or in the section titled "Ecological Principles". How can freshwater flow (i.e. the amplitude and shape of the hydrograph) not be described as a major driver of most ecosystem processes and species dynamics in an estuarine ecosystem, especially in a document that is supposed to assess the effect of two of the largest water export facilities in the world? Indeed, buried in an extremely academic section regarding the ecosystem's "Intrinsic Potential" (A.2.7.1.1), the document finds that:

> *Flow is a "master variable" (Poff et al. 1997) in aquatic systems in the sense that it is responsible for creation and maintenance of many habitat features affecting biological potential. Characteristics of flow include magnitude, frequency, duration, timing, and rate of change that result in the natural dynamics of the system that structures biodiversity and ecological function of riverine (Stanford et al. 1996) and estuarine (Peterson 2003) systems. The natural flow regime of the system is controlled by the drivers of climate (precipitation and temperature), geology (topography and channel form), and biogeography (vegetation), which control the supply and pathways of water reaching stream channels (Poff et al. 1997)* [p. A-28].

Even when it acknowledges the effects of flow, however, the document wholly ignores the profound effects on flow caused by the operations of the federal and state water projects, as well as other diversions. These operations have, as Enright & Culberson 2010 concluded, "decoupled long-term trends in annual mean outflow and salinity from long term trends in precipitation." Furthermore, even when the document eventually describes the role of flow in the Delta, it marginalizes the importance of flow as "only" affecting the system's "biological" response – freshwater flow is also a major driver of physical and chemical processes in this (and any other) estuary (e.g., Kimmerer 2002(b); 2004).

In sum, the BDCP's Conceptual Foundation and Analytical Framework is not based on our best scientific understanding of this admittedly complex ecosystem but rather on BDCP's assumption that the ecosystem and covered species are largely limited by two things: (1) entrainment and habitat destruction caused by the current water export facilities and (2) lack of shallow water habitats. Thus, the Conservation Strategy does not acknowledge or seek to address the impacts of other known stressors (including those directly related to the water project operations for which BDCP seeks a long-term permit); the Analytical Framework is left incomplete, restricted to evaluating a limited subset of system responses; and the resultant EA is incapable of determining whether and to what extent the analyzed alternative will contribute to the ecosystem and species recovery required for the BDCP.

4. <u>The Analytical Framework relies extensively on a very narrow set of tools to analyze the impact of the stressors it assumes are most important to this ecosystem and covered species.</u>

The document identifies a number of quantitative and conceptual models that will be utilized in the EA and section [A.3.3.6] on the integration of results and roll-up discusses the use of qualitative methods and numerous quantitative methods (see Table A-8 in the document). There is no explanation of whether and how the quantitative modeling tools were selected or description of how the models were vetted prior to selection, which should include screening for consistency with conceptual models and our best scientific understanding of stressors affecting covered species. During the past several years and in their own review of this document, the California Department of Fish and Game (CDFG), National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), independent scientific reviews, and other experts have repeatedly identified significant scientific concerns with regard to many of the quantitative models that are identified in the document. Yet, the Conceptual Foundation and Analytical Framework document fails to acknowledge these well-documented scientific concerns with the accuracy and validity of several of these models, including the Delta Passage Model, Maunder-Deriso Life Cycle Model,[1] Glibert Foodweb Regression, IOS, SALMOD, Manly 2011/salvage estimation equation. Similarly, the document makes no mention of other available (and well-documented) tools that could be used instead of the ones it has selected.

5. <u>The Conceptual Foundation and Analytical Framework fails to adequately explain how effects, including indirect and cumulative effects, will be integrated and identifies no process for revision of the Conservation Strategy based on findings of the analysis.</u>

The document briefly summarizes the proposed process by which the effects of BDCP will be integrated, stating that qualitative methods will figure prominently in the "roll up," including the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) conceptual models (see A-53). It also discusses goals and objectives and the viable salmonid population measures (i.e., VSP criteria; species abundance, productivity, spatial distribution and life history diversity), all of which are essential to the effects analysis (see A-32). However, it is completely unclear how the methodology described in the Analytical Framework for integrating results will answer the ultimate question of whether the BDCP contributes to the recovery of covered species. As described above, the document does not include identification or useful descriptions of biological goals or SMART objectives, and, if the Conservation Strategy is currently inadequate, the EA can neither determine this nor identify what modifications to the Conservation Measures would allow for attainment of goals and objectives within their specified time-bounds. There is no indication that the EA will determine whether covered species will persist and recover over the 50-year term of BDCP, including increased abundance, productivity, life history diversity, and spatial distribution. It is not sufficient to analyze the effects on covered species in different water year types; the EA must look forward over the duration of the permit period to demonstrate that the BDCP will contribute to recovery and meet other statutory obligations (e.g., salmon doubling under state and federal law, fully mitigating and minimizing impacts on species under CESA/NCCPA).

In addition, the description of integration and roll up of effects does not discuss cumulative effects from other foreseeable projects, although the document acknowledges such analysis is legally required (see A-10, A-68). For instance, the analysis appears to rely on CALSIM modeling results that show Old and Middle River flows more positive than what is actually required by the operational rules in the analyzed alternative, but additional storage, increased

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[1] For instance, the document should acknowledge that the Maunder and Deriso (2010) model explains only 25% of the variability in adult delta smelt abundance, far less than simple stock recruitment relationships based on prior abundance, and that the model finds that density dependence is a significant factor affecting abundance, despite the author's admission that delta smelt are not currently density dependent.

upstream demand, and other reasonably foreseeable factors may result in operations that increase exports (and increase negative OMR flows) up to the operational rules required in the alternative. The EA's integration of effects must incorporate cumulative effects, upstream effects, potential multi-year droughts, and other reasonably foreseeable projects and stressors to provide a sound analytical basis for determining whether BDCP will contribute to recovery of covered species over the 50-year time frame.

In the end, effects revealed through the EA process must be summarized for comparison to the biological goals and objectives of the BDCP. The EA should be a planning tool that accurately reflects the magnitude and uncertainty of environmental response associated with a given set of conservation measures and covered activities. Those outputs should then be compared with the BDCP's goals and objectives so that, if the analyzed alternative falls short, the Conservation Strategy and conservation measures can be appropriately modified. Indeed, such a process is necessary because, as the document states: *There are many sources of uncertainty in understanding a complex system and predicting its responses to interventions and change.* This fact means that it is extremely unlikely that any group of planners, no matter how astute or well intentioned will identify the "best" conservation strategy in their first attempt.

This is why an iterative process to development of the Conservation Strategy must be implemented, as was already agreed to by the parties (e.g. in the "Notes to Reviewers" regarding the Chapter 3. "Conservation Strategy" or "Section 3.4.2.1 CM 1 Water Facilities and Operation" of the November 2010 BDCP "draft"). By contrast, what has been developed by the BDCP consultants and described in the Conceptual Foundation and Analytical Framework document will produce a simple "report" on a single analyzed alternative's effects, with neither a method nor a guarantee that its outputs can (much less "will") be used to improve the Conservation Strategy.

6. <u>The Conceptual Foundation and Analytical Framework presents a list of "Ecological Principles" that are actually a set of pre-made excuses to set low expectations for conservation and restoration success.</u>

Section A-2.6 describes a list of "Ecological Principles" derived from recommendations of the BDCP Science Advisors. The document states: "*these statements provide the overall assumptions and perspective of the BDCP effects analysis*". We seriously question whether many of the statements in this section rise to the level of "ecological principles"; rather, they appear to be simple maxims for planning in a complex environment. However, as they are presented in the document, these "principles" appear to be provided as reasons to conclude that the BDCP cannot accomplish meaningful ecosystem restoration or contributions to species recovery, as is required for this type of HCP/NCCP process.

Below, we assess some of the "principles" individually to demonstrate their likely negative effect on planning and evaluation in the BDCP context:

- *Changes in the estuarine ecosystem may be irreversible* (see A-25).

Taken together with the diagram in Figure A-9 and the document's unquestioning adoption of the regime shift "hypothesis"[2], this statement implies that a restored ecosystem cannot, in some cases, be *improved* over conditions found in the late-middle of the past century. However, BDCP proposes to restore habitats that were destroyed before long-term monitoring of the aquatic community began in the late 1960's and has the potential to provide sufficient flow to make these habitats productive. We believe that, in some cases, BDCP can improve on ecosystem conditions we have seen since the "irreversible changes" were made. By adopting a "principle" that "the damage can't be undone", BDCP limits the potential to achieve significant progress in restoring certain species and ecosystem processes in the Delta.

- *Achieving desired ecosystem outcomes will require more than manipulation of a single ecological stressor.*

We agree with this statement and would expand it to suggest that ecosystem restoration and species recovery will also require manipulation of more than <u>two</u> ecological stressors. How does this square with BDCP's primary focus on just two potential ecosystem stressors (entrainment and water-land interface "habitat" space) to the exclusion of other well-known problems in the Delta? In particular, the Conceptual Foundation and Analytical Framework document and currently proposed Conservation Strategy largely neglect the potential of addressing the altered flow stressor to address multiple physical and ecological impairments to the Delta ecosystem (e.g. physico-chemical habitat space, food supplies, water quality, transport between habitats, entrainment, etc.). In fact, as noted earlier, the EA does not even appear to account for changes in the freshwater flow driver in its evaluation of project impacts to the covered species and the ecosystem. If BDCP's Conceptual Foundation and Analytical Framework is truly based on the principle that recovery of species and ecosystem processes in the Bay-Delta will require addressing numerous stressors, then restoration of freshwater flow volumes and timing must receive significant attention in the Conservation Strategy.

- *Habitat should be defined from the perspective of a given species*

This principle is inconsistent with the BDCP Conservation Strategy's apparent endorsement of "conservation measures" that are defined in terms of habitat "cover types" [Table A-2; p.A-8]. The document indicates that Habitat Suitability Models (HSMs) will be used to evaluate effects on covered species. However, these HSMs are not described in the document or made available for review; therefore, we cannot assess the EA's ability to accurately assess "habitat" restoration for species. In addition, the document inaccurately claims that: "*for covered fish species such as longfin smelt, delta smelt, splittail, and sturgeon, life history models do not exist or are still relatively new*" (see A-55), further undermining the scientific validity of the EA. In fact, life history conceptual models for these species developed through the DRERIP program are well-documented, peer-reviewed frameworks that present the best available information on the habitat use and needs of these species.

[2] Although ecosystem components and dynamics have changed in rec ent decades, it is likely that they have always been changing., but this says nothing of our ability to restore certain species or habitats or to enhance certain targeted ecological processes. The notion that today's Delta responds in a *fundamentally different* way to driving forces than it did historically is neither testable nor useful in terms of predicting the course or limits of change or how to affect those.

- *Conservation measures to benefit one species may have negative effects on other species*

All of the covered species co-existed in this ecosystem for millennia—there is no inherent conflict between the continued co-existence of these species. Conflicts result from the human-induced changes to the ecosystem including, most significantly, federal and state water project infrastructure and operations. These impacts are not unavoidable states of nature—they are malleable in all aspects and can be modified to protect and contribute to the restoration of endangered species. A BDCP developed based on the premise on potential "conflict" between restoration of different covered species is not likely to meet the requirements of an HCP/NCCP.

- *Adaptive management is essential to successful conservation & prevention of undesirable ecological responses is more effective than attempting to reverse undesirable responses after they have occurred.*

Both of these statements are true, though they are not "ecological principles" but planning principles central to the development of a sound BDCP Conservation Strategy.

Rather than misidentify planning principles as "ecological principles", we suggest that the Conceptual Foundation and Analytical Framework for the BDCP EA identify actual ecological principles that are relevant to conservation and restoration in this ecosystem. For example, the document should incorporate actual ecological principles such as:

- freshwater flow into an estuary defines the estuary's boundaries, and its ecosystems and species are expected to respond strongly to variations in freshwater flow within and among years (e.g. Schlacher and Woolridge 1996; Estevez 2002)
- all else being equal, populations with narrow geographic ranges are typically more susceptible to extinction than those with broader ranges – this is particularly true in freshwater ecosystems (e.g. MacArthur and Wilson 1967; Laurance et al. 2002; Rosenfield 2002);
- decreasing variability in certain key ecosystem attributes (e.g. flow, habitat types, species composition) typically allows certain species to dominate the biomass in an ecosystem, whereas variability and "disturbance" are essential for maintaining maximum native diversity in an ecosystem; (e.g. Connell 1961)
- species invasions and high-population growth rates of non-native species are typically associated with human disturbances and management that eliminates historic patterns of variability and/or the abundance of native species (e.g. Marchetti et al. 2001);
- the inherent conflict between the different ecological needs of species using the same areas at the same time does not prevent the co-existence of those species; conflicts in the ability to conserve and restore different native species arise, fundamentally, from human demands on and activities in the ecosystems in question.
- natural variability in species life history (e.g. spawning period, growth rates, age at first reproduction) typically reflects that different life history paths were successful to some degree in environments that were historically available; these variants may represent critical elements in the species' ability to persist through environmental variation in the future (e.g. Beechie et al. 2006).

7. The Methodological Framework and Conceptual Foundation document improperly draws conclusions before the analysis has been performed, thereby inexcusably limiting the scope and outcomes of the analysis.

The EA's Conceptual Foundation and Analytical Framework should describe methods that will be used to answer foundational technical questions and evaluate the effects of individual and combined conservation measures; conclusions regarding the outcome of analyses have no place in these documents. Despite this general principle, the document presents a number of conclusions without any reference to an analysis that would support them. For example, at Page A-30, the document states:

> *...restoration of tidal wetlands (Conservation Measure 4) is an enhancer for delta smelt because it is intended to provide key habitat while improving water quality and contributing to the delta foodweb.*

The basis for this conclusion that restoration of tidal wetlands is beneficial for delta smelt is not provided. In fact, recent scientific reviews conducted by the National Research Council studying the Delta smelt Biological Opinion (2010) and BDCP itself (i.e., the DRERIP reviews) found little or no support for this species-habitat relationship.

Similarly, it is completely inappropriate for the document to conclude, prior to any analysis, that dual conveyance "*should allow increased export of water beyond the current levels and allow this portion of the Delta to improve ecosystem functions.*" (see A-4). These and similar statements in the document suggest a prejudged outcome of the analysis, diminishing both the substance and validity of BDCP's Conceptual Foundation and Analytical Framework. We are disappointed that just a half a year after a National Research Council review panel (NRC, 2010) concluded that "much of the BDCP appears to be a post-hoc rationalization of the water supply elements contained in the BDCP" and called the BDCP "a list but not a synthesized plan for the restoration activities," it appears that little has changed.

8. The Conceptual Foundation and Analytical Framework Utilizes a Deficient Baseline for Comparison of Impacts

Accurate and adequate analysis of the environmental effects of BDCP (both positive and negative) depends upon an accurate description of the environmental baseline. However, the baseline utilized in the EA inappropriately excludes certain requirements of the existing biological opinions, including the Fall X2 action and numerous habitat restoration actions required under both biological opinions (see A-63 to A-65). There is no justification for excluding these regulatory requirements from the description of the environmental baseline; indeed, the document elsewhere acknowledges that implementation of BDCP may help meet the habitat restoration requirements of the biological opinions (see A-13).

As a result of omitting these requirements from the baseline description, the Existing Biological Conditions ("EBC") as described in the documents are less environmentally protective than what is actually required, and EA is likely to overestimate the benefits of the proposed project as a result. For instance, an accurate description of the EBC-ELT should include substantial requirements to restore and inundate floodplain habitat to benefit salmonids by 2020, and it is unclear whether the proposed project will restore as much floodplain habitat as required under the EBC conditions, let alone restore more than what is currently required under EBC. Likewise, omitting the Fall X2 action from some of the descriptions of the environmental baseline omits a critically important measure that the USFWS and CDFG have determined are necessary to avoid jeopardy to delta smelt.

9. <u>The Effects Analysis fails to analyze a full range of BDCP alternatives.</u>

Thus far, the BDCP EA methodology has only been applied to a single preliminary alternative, and the Entrainment Appendix (Appendix B) suggests that the EA will only analyze one other alternative (see A-60; Appendix B at Summary Page B-1, stating that the entrainment appendix will be revised to include one other alternative, and that "Evaluation of both operational scenarios will inform selection of the Proposed Project upon completion of the Effects Analysis."). Both of those alternatives rely on a 15,000 cfs diversion facility;[3] unless the full range of alternatives are considered, the EA will not analyze a fully isolated conveyance alternative, nor a full range of canal sizes (1-5 intakes), flows, and resulting water exports. A scientifically defensible EA depends on analysis of a full range of alternatives, particularly where the EA intends to provide comparative, rather than absolute, results.

10. <u>The geographic scope of the Effects Analysis must focus on the BDCP Study Area, so that the effects of upstream reservoir operations and downstream effects are analyzed</u>

The conceptual foundation and analytical framework properly acknowledges that the BDCP study area includes upstream reservoirs and rivers. However, the document also troublingly states that, "much of the analysis is focused at the geographic subregional level"(see A-43). While adequate analysis in the BDCP Plan and subregional level is essential, so too is analysis at the Study Area level. The federal and state water projects are operated as a system linking operations in the Delta (potentially including elements of the BDCP) and upstream reservoir releases, and these systemic operations substantially affect flows, water temperatures, and numerous biological factors (including the survival and abundance of covered species) upstream of the BDCP Plan Area. Likewise, effects of BDCP and water project operations reach downstream into Suisun Bay and San Francisco Bay, and will result in benefits and impacts downstream as well (a point that the 2010 NRC panel emphasized as well). The EA must likewise take a systematic approach that includes upstream and downstream effects, rather than looking at the Delta in isolation.

11. <u>The Effects Analysis deals inadequately with scientific uncertainty, and rarely provides confidence intervals or other quantitative measures of uncertainty for quantitative models</u>

While the document acknowledges uncertainty, it is generally in the context of future adaptive management or to lower expectations for the BDCP's positive impact. The proposed analyses rarely quantify and disclose the uncertainty associated with various quantitative models, which is

[3] In addition, the EA improperly describes increased water exports from the Delta as a conservation measure, and it also incorrectly describes operation of a new intake facility as a conservation measure (see A-4). Even assuming that operation of a new intake facility may reduce and partially mitigate the impacts of water exports from the Delta, the facility itself is not a conservation measure.

essential. Explicit measures of uncertainty should be incorporated into the EA. Even where numerical quantification of uncertainty is not possible, it is possible and necessary to categorize the uncertainty associated with individual and combined conservation measures; the DRERIP evaluation process provides explicit instruction for how to categorize risk in a qualitative, yet meaningful, fashion. Such a discussion of uncertainty is particularly important, given the 50-year permit term that is being proposed for the BDCP.

Moreover, by failing to identify key uncertainties in the major assumptions of the Conservation Strategy or in the quantitative models used to assess that strategy, the document again fails to support adaptive management. The EA can and should identify key assumptions and major uncertainties because these should: (a) modify any conclusions drawn regarding the magnitude of projected impacts under the plan; and (b) become the targets of the (still undescribed) BDCP adaptive management process.

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Comments on the BDCP Entrainment Appendix

Not surprisingly, many of the general problems described above for the Conceptual Foundation and Analytical Framework (Appendix A) are evident in the EA's Entrainment Appendix (Appendix B). In addition, we find that Appendix B is scientifically unsound in both its incorporation of the best available science and in its selective interpretation of the results generated using an inadequate set of quantitative models and other tools. As a result, this document is totally inadequate to evaluate the impacts of BDCP on entrainment of the covered fish species and impacts to aquatic habitats throughout the Delta.

1. <u>The Entrainment Appendix fails to identify the specific questions it addresses, including how entrainment relates to the goals and objectives for covered species and the ecosystem</u>

The BDCP is not intended to reduce entrainment for the sake of reducing entrainment; if entrainment mortality and associated local habitat destruction is a stressor or limiting factor for particular species or ecosystem attribute (and we believe the evidence is clear that they are), then reduction of entrainment should contribute meaningfully to BDCP's conservation and recovery goals and objectives. However, the entrainment EA articulates neither goals nor specific objectives related to entrainment, survival through the Delta or expanse or quality of habitat types in the South Delta. As a result, there is no way to determine whether any particular reduction in entrainment-related mortality or habitat destruction, much less results described for analysis of this single alternative, would achieve the BDCP's species abundance or habitat expanse goals and objectives (which, as we have noted in our comments above, are also missing from BDCP's Conceptual Foundation and Analytical Framework). In other words, the fundamental question that entrainment EA needs to and fails to address is: *How much of a reduction in entrainment-related mortality or export-related habitat destruction is enough to make a difference to either covered species' populations or the ecosystem as whole?*

Entrainment at the South Delta pumps also contributes to reduced spatial extent of covered species that live in the Delta and, if entrainment-related mortality is disproportionate across life history variants, to a reduction in life history diversity (e.g. Bennett 2005) that impairs species conservation and recovery. For example, it is widely assumed that Delta smelt and other pelagic fish species cannot be restored to the South Delta as long as the South Delta pumps remain in operation. Similarly, the timing of export pumping, and thus, the potential for disproportionate entrainment of certain life history strategies (e.g. early spawning, or late migrating fish) could represent an important impact (and even a potential evolutionary threat) to the covered species. However, even though BDCP's Conceptual Foundation acknowledges that the VSP framework applies to pelagic fish species (i.e., abundance, productivity, spatial distribution, or life history diversity, see A-32), neither the Analytical Framework nor the entrainment EA identifies these threats to covered species or incorporates alleviating these stressors into project goals, objectives or effects analysis. Had the BDCP developed and integrated specific goals and objectives related to VSP attributes or similar characteristics fundamental to restored ecosystems, then the entrainment EA could have evaluated whether dual-conveyance and its associated operational regime contributed to those goals.

2. <u>The Entrainment Appendix relies extensively on a very narrow set of tools to analyze the impact of entrainment, ignores much of the existing scientific literature, and relies on scientifically unjustified assumptions.</u>

The Entrainment Effects Analysis ignores or dismisses the majority of the relevant scientific information regarding the role of entrainment in the pelagic organism decline, including DRERIP models, the IEP 2010 POD report (Baxter *et al* 2010), the NCEAS studies on the POD (Mac Nally *et al* 2010 and Thomson *et al* 2010), and Kimmerer (2008 and 2011). While some of these reports are occasionally cited, the entrainment EA document often contradicts the conclusions drawn in these expert studies and published, peer-reviewed journal articles. For instance, Kimmerer (2011) found that mean average entrainment of 10% of the population could result in a 10-fold reduction in population size after 26 years that could not be detected by regression analysis, concluding that "a loss to export pumping on the order reported by Kimmerer (2008) can be nearly undetectable in regression analysis, and devastating to the population." The entrainment EA ignores this conclusion and cites virtually none of the aforementioned scientific studies regarding the population level effects of entrainment on delta smelt or other pelagic species. Instead, BDCP's entrainment effects analysis relies on work by Deriso and Maunder (2011) and Miller (2011) to argue that entrainment is not significant (while also arguing that there are substantial benefits from reducing entrainment; see BDCP Conceptual Foundation, page A-3). Based on this, neither the Analytical Framework nor the entrainment EA presented in Appendix B are based on or consistent with the best available science.

In addition, virtually no information or analysis from the existing biological opinions for smelt or salmonids is referenced or utilized in the entrainment EA, despite the broad scientific recognition that these peer-reviewed opinions were based on substantially sound science. For instance, the EA's discussion and analysis of OMR:salvage relationships for salmonids is limited to one paragraph and one graph prepared by Deriso in 2010 (see B-52 to 53), and it ignores numerous other studies and technical work that have found significant relationships between entrainment and OMR and/or exports for salmon (e.g., Kimmerer 2008) and non-salmonid species (Grimaldo *et al* 2009). The document appears to wholly ignore the methodology used in Kimmerer 2008 to estimate salmonid entrainment and mortality.

Many of the models identified in the document, particularly Deriso & Maunder 2011 and the Delta Passage Model, have substantial scientific flaws that the CDFG, USFWS, NMFS, U.S. Bureau of Reclamation, and other independent reviewers have identified. For instance, the Deriso & Maunder model assumes strong effects of density dependence on the delta smelt population, but Dr. Deriso has acknowledged that the delta smelt population does not exhibit density dependence. A recent Delta Science Program independent review panel recommended that NMFS not rely on the Delta Passage Model, instead recommending that NMFS create its own model. Moreover, CDFG, NMFS and USFWS have documented many of their significant concerns about these models in prior comments on the EA and in other documents. Finally, critiques by the NGO community, that were part of earlier reviews of draft EAs, identified problems with some of the models used here (particularly Delta Passage Model); yet the entrainment EA never acknowledges the outstanding critiques of any of the modeling tools or assumptions it employs.

Even when other models are used, it is unclear whether the EA accurately utilizes them. For instance, in the delta smelt entrainment analysis purporting to be based on Kimmerer 2008, the EA appears to use four month average OMR flows, a May to July time period for juvenile entrainment, and shows a maximum of 25% of the adult population entrained. However, Kimmerer 2008 used daily OMR flows and salvage information, modeled juvenile entrainment over the March to July time period (and found peak entrainment in April), and estimated a maximum of 50% of the adult population was entrained. Indeed, the EA repeatedly refers to "Kimmerer (2008) as reported in Miller (2011)," (see B-45), suggesting that the consultants preparing the EA may not have actually reviewed the Kimmerer 2008 and Kimmerer 2011 source studies. In another example, the EA reports that under the Miller 2011 analysis, adult entrainment of Delta smelt under most assumptions is estimated to be zero in drier water year types under EBC or BDCP (see B-211, 214). This is inconsistent with the other modeling results in the EA, as well as being wholly inconsistent with observed salvage under the biological opinions. Likewise, the weighted salvage approach estimates that only 39 adult delta smelt are entrained on average under EBC (see B-205). This result appears scientifically indefensible, and the weighted salvage approach itself appears to be of questionable utility.

Other modeling concerns include:

- Estimates for larval and juvenile entrainment exclude the months of March and April, despite historic salvage information and findings of Kimmerer 2008 that juvenile salvage peaks in April and can also occur in March;
- The assumption of fixed numbers of salmonids reaching the Delta appears not to incorporate acoustic tagging results from 2007-present which shows survival to the Delta is far less than the 50% rate assumed in the document);
- It is unclear whether the models incorporate the effects of other conservation measures and actions. For instance, reduced Sacramento River flows below a new intake facility are likely to substantially alter the distribution of Sacramento River salmonids, potentially increasing distribution into the central Delta (and thus increasing the risk of entrainment, as well as lowering estimates of survival). Likewise, changes in the geometry of the Delta from habitat restoration will likely alter flow and hydrodynamic patterns, potentially altering entrainment. It is unclear whether the analysis considers these and numerous other synergistic effects of BDCP.

Overall, the entrainment EA's methods, analytical tools and results for the single analyzed alternative appear inconsistent with the best available science. We strongly recommend that the agencies bring in additional outside reviewers who have expertise with the covered species to work with the consultants and the agencies to ensure that the entrainment EA is substantially revised.

3. <u>The Entrainment Appendix Appears to Be Internally Inconsistent Regarding Entrainment Effects on Covered Species.</u>

The Entrainment EA finds that, in most cases (but not all), BDCP's Conservation Strategy and operations will lead to reduced entrainment of covered species, and suggests that this will benefit these species while simultaneously suggesting that entrainment of these species has minimal effects under current conditions. These two conclusions are inconsistent and should trigger reflection on both BDCP's Conceptual Foundation and Analytical Framework, as well the specific analytical tools used to analyze proposed project effects on entrainment.

In addition, in many cases the various models used in the entrainment EA yield contradictory and inconsistent results. For instance, the document reports that the salvage density methodology yields entrainment estimates that are an order of magnitude higher than the Delta Passage Model for several salmonid runs (see B-6 to B-7). No explanation for this substantial difference in results is provided, nor does the document offer any information about which model yields more accurate results.

Similarly, for entrainment of juvenile delta smelt, the different analytical methods used produce substantially inconsistent results regarding the magnitude of entrainment as a proportion of the population, and whether entrainment will increase or decrease as a result of BDCP. For example:

- <u>Salvage-Density (page B-191 to 196)</u> analysis reports an average of ten to hundreds of smelt entrained under EBC (not scaled to population size, despite statements on page B-37 that the method would be scaled to population size), and concludes entrainment would decrease under BDCP in wet years, dry and critical years, but that BDCP would increase entrainment in above normal and below normal years as compared to EBC-ELT and EBC-LLT;
- <u>Kimmerer 2008 (page B-197 to 198)</u> reports approximately 10% of juvenile population entrained on average under EBC, with highest proportional loss to entrainment in above normal to dry year types, and that finds that entrainment would decrease in all year types under BDCP.
- <u>Miller 2011 (page B-199 to 204)</u> reports an average of 5% (range of under 2% to under 10%) of juvenile population entrained on average under EBC, with entrainment increasing under BDCP on average (EBC-ELT vs. PP-ELT), increasing in below normal, dry, and critical water year types, and increasing the percentage of years in which more than 10% of the population is entrained.

In other words, BDCP's entrainment effects analysis (of the single alternative analyzed) concludes that entrainment will either increase or decrease under the project and that some portion of the population will be entrained, but the information provided is self-contradictory and there is virtually no explanation of what benefit would be provided to the species from changes in entrainment.

Relatedly, the entrainment appendix compares larval delta smelt entrainment at the South Delta under EBC vs. PP, but it never actually compares delta smelt larval entrainment mortality under BDCP vs. EBC, which would require adding North Delta mortality to the estimates of entrainment mortality at the South Delta intakes under PP. All of this confusion relates back to the fact that the EA fails to set a biological goal (e.g. increase survival of pre-spawning Delta smelt), much less an objective that defines that goal (e.g. increase survival of pre-spawn Delta smelt by __% within __ years of project implementation) and then compare proposed mechanisms (reduce entrainment, increase food supply, reduce predation) for contributing to that goal/objective in terms of their projected efficacy and likelihood of success.

4. <u>The Entrainment Appendix makes scientifically unjustified assumptions that lack citation, and fails to identify and explain key assumptions and modeling results.</u>

It is difficult to assess the assumptions that are incorporated into the modeling in the entrainment EA. For instance, at least some of the critical assumptions that are clearly identified in the document lack citation or scientific foundation, including:

- <u>North Delta Screening Effectiveness</u>: The documents makes numerous statements regarding the effectiveness of fish screens at the North Delta intakes, assuming that there would be no impingement or entrainment mortality for adult delta smelt or salmonids (see B-69, B-304). However, these intakes would use some of the largest fish screens in the world, and concern is heightened by the series of five such screens. While the document includes some analysis of potential delta smelt larval entrainment at the North Delta intakes (1-3% of the population), there is no acknowledgement of the existing body of scientific research on mortality associated with impingement (*see, e.g.,* Young, Swanson, and Cech 2010). The appendix must include some analysis, such as PTM results, to quantify potential impingement and mortality of adult delta smelt. Similar concerns exist for salmonids as well; the document should incorporate the results of monitoring for the 3,000 cfs fish screen operated by Glenn Colusa Irrigation District**.**
- <u>Estimates of Delta Smelt Population in Cache Slough:</u> The entrainment EA asserts that 20-80% of the delta smelt population reside in Cache Slough, and the document assumes that 60% of the population exists in Cache Slough in some models (see B-49, B-58). No scientific justification or citation is provided for these numbers, which appear unjustified and biased upwards (e.g., see Sommer *et al* 2011). In addition, further clarification is needed regarding the statement on page B-48 that Kimmerer 2011 found that the adult delta smelt entrainment estimates in Kimmerer 2008 could be reduced by 25%; we did not find that conclusion in Kimmerer 2011.
- <u>Effectiveness of Nonphysical Barriers:</u> The entrainment EA makes assertions regarding the effectiveness of nonphysical barriers in reducing entrainment (see B-302). The document fails to provide details of the studies by Bowen (2009, 2010) and others, which have demonstrated little or no survival benefits for salmonids and very low deterrence effects at higher flows. The document appears to overstate the effectiveness of nonphysical barriers in reducing entrainment and improving survival.

These assumptions can substantially affect the accuracy of modeling outputs regarding entrainment, and may result in significant underestimates of the impacts of entrainment on covered species.

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